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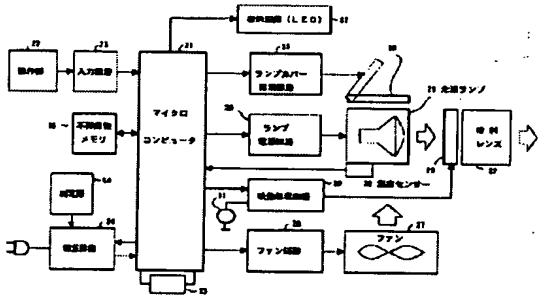
(54) [Title] PROJECTION TYPE DISPLAY DEVICE

(57) Abstract

Purpose: The purpose is to provide a projection type display device that controls the lamp power source circuit according to the cooling state of the lamp when the AC power supply is suddenly interrupted and resets the AC power supply in order to cool the lamp sufficiently.

Constitution: The present invention provides a projection type display device characterized by having a light source lamp and a fan for cooling it; and having a lamp power supply circuit that controls lighting of the light source lamp, a fan controller that drives the fan, and a controller that controls the aforementioned circuits; after detecting interruption of the AC power supply, the time until the AC power supply is then reset is counted to determine the cooling period of the power supply lamp; and the lamp enters standby mode until a sufficient cooling period has passed.



Key:
21 Microcomputer
22 Operation part
23 Input circuit
24 Power supply circuit
25 Light source lamp
26 Lamp power supply circuit
27 Fan
28 Fan controller
30 Image processor
32 Projection lens
34 Secondary power supply
35 Nonvolatile memory
36 Temperature sensor
37 Display circuit (LED)
38 Lamp cover opening/closing circuit

Claims

1. A projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having:

a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation,

an operation part that instructs the power supply of the device to turn on/off,

a lamp power supply circuit that controls the turning-on of said light source lamp,

a fan controller that drives said fan,

and a controller which, with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller, and, at the same time, detects interruption of said AC power supply and counts the time until the AC power supply is then reset;

where said controller operates as follows: when the AC power supply is reset, corresponding to the result of said counting of time, when the interruption period of said AC power supply is shorter than a prescribed time, said lamp enters standby mode.

2. The projection type display device as cited in Claim 1 characterized in that said controller includes a time counter, which sets the time count to zero when said AC power supply is interrupted, and which counts up upon resetting of the AC power supply.

3. The projection type display device as cited in Claim 1 characterized in that said controller determines the off period of the AC power supply based on the difference between the time of interruption of said AC power supply and the time of resetting of said AC power supply.

4. The projection type display device as cited in Claim 1 characterized in that said controller controls said fan controller and said lamp turn-on circuit such that when power is turned off by said operation part, rotation of said fan is stopped after said fan is driven to further rotate for a prescribed period of time.

5. A projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having:

a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation,

an operation part that instructs the power supply of the device to turn on/off,

a lamp power supply circuit that controls the turning-on of said light source lamp,

a fan controller that drives said fan,

a temperature sensor that measures the temperature of said light source lamp,

and a controller which, with the power source voltage from said power supply part, control, the operation of said lamp power supply circuit and said fan controller;

where said controller operates as follows: when the AC power supply is reset, corresponding to the result of measurement of said temperature sensor, when the temperature of said light source lamp exceeds a prescribed level, said lamp enters standby mode.

6. The projection type display device as cited in Claim 5 characterized in that said controller controls said fan controller and said lamp turn-on circuit so that after the power supply is turned off, said fan is driven to further rotate for a prescribed period of time, and, corresponding to the result of measurement of said temperature sensor, when the temperature of said light source lamp is lower than a prescribed level, rotation of said fan is stopped.

7. A projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having:

a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation,

an operation part that instructs on/off of the power supply of the device,

a lamp power supply circuit that controls turning-on of said light source lamp,

a fan controller that drives said fan,

a temperature sensor that measures the temperature of said light source lamp,

a controller, which with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller and, at the same time, determines the cooling state of said light source lamp,

and a display device that operates under control of said controller and indicates the abnormal state of said AC power supply being turned off;

where said controller operates as follows: after said AC power supply is turned off, display of said display device is continued until said lamp is cooled so that the temperature of said lamp is lower than a prescribed temperature, and the restart of said lamp enters standby mode during the display period.

8. The projection type display device as cited in Claim 7 characterized in that after said AC power supply is interrupted, said display device flashes until said temperature of said light source lamp decreases to lower than a prescribed temperature.

9. The projection type display device as cited in Claim 7 characterized in that the means that determines the cooling state of said light source lamp consists of a time counter that measures the period when said light source lamp is off.

10. The projection type display device as cited in Claim 7 characterized in that the means that determines the cooling state of said light source lamp consists of a temperature sensor that measures the temperature of said light source lamp.

11. A projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having:

a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation,

an operation part that instructs the power supply of the device to turn on/off,

a lamp power supply circuit that controls the turning-on of said light source lamp,

a fan controller that drives said fan,

a controller which, with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller, and, at the same time, which determines the cooling state of said light source lamp,

and a heat-exhaust part set near said light source lamp to exhaust heat of the lamp;

said controller operates as follows: when the AC power supply is off, said heat-exhaust part is controlled to exhaust heat from the lamp, and, at the same time, when the AC power supply is reset, the state of heat exhaust from the lamp is determined while it stands by for restarting of said lamp.

12. The projection type display device as cited in Claim 11 characterized in that said heat-exhaust part consists of a device that can open/close the lamp cover of said light source lamp, and said controller controls to open said lamp cover when said AC power supply is interrupted.

13. The projection type display device as cited in Claim 11 characterized in that when the AC power supply is reset, while said lamp cover is open, it stands by for the turning-on of said light source lamp.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a liquid crystal projector or other projection type display device having a light source.

[0002]

Prior art

With a liquid crystal projector or the like, the liquid crystal panel or the like is irradiated with light from a light source, and the panel is modulated according to the television video signal or the information from a personal computer. The image light is emitted from the lamp, and, as it goes through a projecting lens, the image is projected on a screen.

[0003]

Figure 7 is a block diagram illustrating the constitution of a liquid crystal projector of the prior art. (1) represents a microcomputer (hereinafter to be referred to as microcomputer (1)), and it controls the operation of the projector. Input circuit (3), which receives instructions from a remote control, a key input circuit, or other operation part (2), is connected to microcomputer (1), and, at the same time, power supply circuit (4) is connected to the microcomputer.

[0004]

There are also the following parts: lamp power supply circuit (6) that turns light source lamp (5) on/off, fan controller (8) that controls driving of fan (7) to cool said lamp (5), and image processor (10) that controls liquid crystal panel (9). The operation of aforementioned circuits (4), (6), (8), (10) is controlled by microcomputer (1). Also, signal source (11) is connected to image processor (10), and the video signal obtained by receiving and processing the television broadcast signal and the information signal from the personal computer are fed from signal source (11).

[0005]

Said lamp (5) emits light on liquid crystal panel (9), and liquid crystal panel (9) is modulated by the signal from image processor (10), so that the intensity of the transmitted light is controlled. The image light from liquid crystal panel (9) is projected via projecting lens (12) on a screen (not shown in the figure) for display.

[0006]

Here, said light source is usually a high-voltage discharge lamp, such as a metal halide lamp or halogen lamp. Because a high voltage must be applied on the lamp, lamp noise is generated when it is on, causing microcomputer (1) to operate incorrectly, leading to stress on the circuits that work under a low voltage. If the temperature of the discharge lamp when voltage is applied is not lower than a prescribed level, the lamp cannot be turned off. Consequently, when one tries to turn on the lamp when it becomes warm after it was turned off, the lamp may

not turn on, or noise may be generated for a long time, so that stress is applied on microcomputer (1), etc.

[0007]

Consequently, with the projector of the prior art, after the power supply is turned off by operation part (2), the lamp is turned off while fan (7) is kept rotating for a prescribed time to cool the lamp. Then, the fan is stopped, and the power supply is turned off. However, although there would be no problem if the user follows the correct procedure in turning off the power supply, when the user pulls out the AC power supply of the projector, or a power outage occurs, the AC power supply is interrupted suddenly, rotation of the fan is also stopped, so that the lamp cannot be well cooled. Although the temperature of the lamp falls after a rather long time has passed since the power was turned off, if the lamp is not sufficiently cooled down, when the AC power supply is later turned on, fan controller (8) does not rotate fan (7), so that while lamp power supply circuit (6) tries to turn on the lamp, the lamp may not turn on, or noise may be generated for a long period of time. Both are undesired.

[0008]

Japanese Kokai Patent Application No. 2000-131763 disclosed a method for shortening the cooling time after the lamp is turned off by means of the following method: it has a cooling means for cooling the lamp and a detection means for detecting the ambient temperature, and the cooling rate by the cooling means is adjusted corresponding to the result of detection of the ambient temperature. However, although this method can shorten the cooling time, it nevertheless does not work when an AC power supply is taken as the means.

[0009]

Problems to be solved by the invention

As explained above, for the projection type display device of the prior art, after the power supply is turned off, fan (7) is kept on for a prescribed time to cool the lamp even after the lamp is turned off. However, in case of a sudden interruption of the AC power supply, because rotation of the fan is also stopped, the lamp cannot be sufficiently cooled. When the AC power supply is later reset, when the lamp power supply circuit tries to turn on the lamp while rotation of the fan is stopped, the lamp may not turn on, or noise may be generated for a long period of time. Both are undesired.

[0010]

The purpose of the present invention is to solve the aforementioned problems of the prior art by providing a projection type display device characterized in that even when the AC power supply is interrupted suddenly, there is still no problem of noise generation or stress on the lamp, etc. in company with the noise when the lamp is restarted.

[0011]

Means to solve the problems

The invention as cited in Claim 1 provides a projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp characterized by having: a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation, an operation part that instructs on/off of the power supply of the device, a lamp power supply circuit that controls turning-on of said light source lamp, a fan controller that drives said fan, and a controller, which with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller, and, at the same time, which detects interruption of said AC power supply and counts the time until the AC power supply is then reset; where said controller operates as follows: when the AC power supply is reset, corresponding to the result of said counting of time, when the interruption period of said AC power supply is shorter than a prescribed time, said lamp enters standby mode.

[0012]

According to the invention as cited in Claim 1, the cooling period of the light source lamp from interruption to resetting of the AC power supply is determined, and standby mode is entered for restart of the lamp until a sufficient cooling period has passed.

[0013]

The invention as cited in Claim 5 provides a projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having: a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation, an operation part that instructs on/off of the power supply of the device, a lamp power supply circuit that controls turning-on of said light source lamp, a fan controller that drives said fan, a temperature sensor that measures the temperature of said light source lamp, and

a controller, which with the power source voltage from said power supply part controls the operation of said lamp power supply circuit and said fan controller; said controller operates as follows: when the AC power supply is reset, corresponding to the result of measurement of said temperature sensor, when the temperature of said light source lamp exceeds a prescribed level, turn-on of said lamp enters standby mode.

[0014]

According to the invention as cited in Claim 5, when the power supply is turned on again after being turned off, the temperature of the light source lamp is measured, and standby mode is entered in order for the lamp to be turned on until the temperature of the lamp is lower than a prescribed temperature.

[0015]

The invention as cited in Claim 7 provides a projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp characterized by having: a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation, an operation part that instructs on/off of the power supply of the device, a lamp power supply circuit that controls turning-on of said light source lamp, a fan controller that drives said fan, a temperature sensor that measures the temperature of said light source lamp, a controller, which with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller and, at the same time, which determines the cooling state of said light source lamp, and a display device that works under control of said controller and indicates the abnormal state of said AC power supply being turned off; said controller operates as follows: after said AC power supply is turned off, display of said display device is continued until said lamp is cooled so that the temperature of said lamp is lower than a prescribed temperature, and restart of said lamp enters standby mode during the display period.

[0016]

According to the invention as cited in Claim 7, when the AC power supply is interrupted, a display of abnormality can be shown to the user, and the display continues until the lamp is sufficiently cooled, and turning-on of the lamp is controlled corresponding to the display state when the AC power supply is reset.

[0017]

The invention as cited in Claim 11 provides a projection type display device that uses the light from a light source lamp to project and display images, and, at the same time, has a fan for cooling said light source lamp, characterized by having: a power supply part, which has a first power supply circuit connected to the AC power supply and a secondary power supply that operates when said AC power supply is interrupted, and which supplies the power source voltage for operation, an operation part that instructs on/off of the power supply of the device, a lamp power supply circuit that controls turning-on of said light source lamp, a fan controller that drives said fan, a controller, which with the power source voltage from said power supply part, controls the operation of said lamp power supply circuit and said fan controller, and, at the same time, which determines the cooling state of said light source lamp, and a heat-exhaust part set near said light source lamp to exhaust heat from the lamp; said controller operates as follows: when the AC power supply is off, said heat-exhaust part is controlled to exhaust heat from the lamp, and, at the same time, when the AC power supply is reset, the state of exhausting heat from the lamp is determined while it stands by for restarting said lamp.

[0018]

According to the invention as cited in Claim 11, it is possible to exhaust the heat of the light source lamp via the heat-exhaust part when the AC power supply is interrupted, and it stands by for turn-on of the lamp until the heat of the lamp has been sufficiently exhausted even when the AC power supply is then reset.

[0019]

Embodiment of the invention

In the following embodiments of the projection type display device of the present invention will be explained. Figure 1 is a block diagram illustrating the overall constitution of the projection type display device of the present invention.

[0020]

As shown in Figure 1, (21) represents a microcomputer (hereinafter to be referred to as microcomputer (21)), and it controls the operation of the projector. Connected to microcomputer (21) is input circuit (23) that receives instruction from operation part (22), such as a remote control, key input circuit, etc., and that is also connected to power supply circuit (24).

[0021]

It also has the following parts: lamp power supply circuit (26) that turns on/off light source lamp (25), fan controller (28) that controls driving of fan (27) for cooling aforementioned lamp (25), and image processor (30) that controls liquid crystal panel (29). The operation of aforementioned circuits (24), (26), (28), (30) is controlled by microcomputer (21). Here, signal source (31) is connected to image processor (30). The video signal obtained by receiving and processing the television broadcast signal or the information signal from a personal computer is supplied from signal source (31).

[0022]

Aforementioned lamp (25) emits light on liquid crystal panel (29), and, as liquid crystal panel (29) is modulated by the signal from image processor (30), it controls the intensity of the transmitted light, and the image light from aforementioned liquid crystal panel (29) is projected via projecting lens (32) onto a screen (not shown in the figure) for display.

[0023]

In the example shown in Figure 1, one liquid crystal panel (29) is used for the projector. However, there may also be the following multi-panel type projector: a plurality (e.g., 3) liquid crystal panels are used, and they are driven by the primary color signals of R (red), G (green), B (blue), respectively. As the light rays from the light source lamp are spectrally divided to R light, G light and B light, these light rays are incident on the respective liquid crystal panels. The light rays exiting from the aforementioned liquid crystal panels are re-synthesized for projection on a screen.

[0024]

Oscillator (33) (quartz) is connected to aforementioned microcomputer (21) to have the real time clock function. Also, aforementioned power supply circuit (24) includes a standby power supply so that input circuit (23), microcomputer (21), etc. can still operate to enable detection of remote control input even when the power is off. Also, secondary power supply (34) made of a charging battery or the like is connected to power supply circuit (24), and secondary power supply (34) keeps microcomputer (21) on when the AC power supply is interrupted. Also, microcomputer (21) determines interruption of the AC power supply by detecting the fall in the voltage when the AC power supply is interrupted.

[0025]

Also connected to microcomputer (21) are the following parts: nonvolatile memory (35), temperature sensor (36), and LED or other display circuit (37). Here, aforementioned nonvolatile memory (35) is for storage of the results of measurement of time by the time clock or the like in microcomputer (21). Aforementioned temperature sensor (36) detects the ambient temperature around lamp (25), and the result of the detection is sent to microcomputer (21). Aforementioned display circuit (37) is for showing the abnormal state of the projector.

[0026]

Also, lamp cover (38) is arranged above lamp (25). This lamp cover (38) can be opened/closed under control of lamp cover opening/closing circuit (39). Here, lamp cover opening/closing circuit (39) can be opened/closed under control of microcomputer (21) or manually.

[0027]

In the following, the operation in the various embodiments of the present invention will be explained. The main features of the operation of the present invention can be summarized as any of the following listed features (1)-(5), or their combination.

[0028]

When the AC power supply is suddenly interrupted,

(1) by means of secondary power supply (34), microcomputer (21) functions, so that the time when the AC power supply is interrupted is stored in nonvolatile memory (35), and, based on the stored time, the lamp cooling period is checked, and countermeasures are taken.

(2) By means of secondary power supply (34), microcomputer (21) functions, so that the time when the AC power supply is interrupted is stored in nonvolatile memory (35), and, based on of the stored time, the period of interruption of the AC power supply is checked, and countermeasures are taken.

(3) By means of secondary power supply (34), microcomputer (21) functions, and LED is displayed by means of display circuit (37) to inform the user of the abnormality.

(4) By means of secondary power supply (34), microcomputer (21) functions, and the ambient temperature around the lamp is detected by temperature sensor (36), and countermeasures are taken according to the state of the temperature when the AC power supply is reset.

(5) By means of secondary power supply (34), microcomputer (21) functions, and lamp cover (38) is opened by lamp cover opening/closing circuit (39) to exhaust the heat from lamp (25).

[0029]

The above is a brief account of the operation when the AC power supply is interrupted. In the following, a detailed explanation will be presented with reference to the flow charts shown in Figures 2-6. First of all, as shown in Figure 2, protection is carried out based on of the lamp cooling period from the time the lamp was turned off.

[0030]

As shown in Figure 2, steps S1-S7 are the operation when power is turned on for the projector. Steps S12-S15 are the operation when power is turned off. Steps S9-S10 and S16-S19 are the operation when the AC power supply is interrupted.

[0031]

In step S1, the AC power supply is turned on. As a result, microcomputer (21) carries out initial setting S2 (for example, initial setting of fan controller (28) and display circuit (37)). In step S3, microcomputer (21) periodically checks variation in the input from the key input circuit. In step S4, it is checked whether there is an instruction to turn on power. When there is an instruction to turn power on, in step S5, the fan power supply is turned on. As a result, fan controller (28) first controls fan (27) to rotate.

[0032]

Then, in step S6, data are read from nonvolatile memory (35); it is determined whether the elapsed time from lamp (25) being off (that is, the cooling period) has reached the prescribed time. If the prescribed time has been reached, in step S7, the lamp power supply is turned on. Also, in step S6, as long as the cooling period of the lamp has not reached the prescribed time, it does not go to the next step S7. When it reaches the prescribed time, lamp power supply circuit (26) is controlled to turn on lamp (25). Also, in step S8, the power supply mode is checked, and it is determined whether the power supply is on .

[0033]

In this way, as fan (27) and lamp (25) are turned on, the operation is normal. However, when the AC power supply is interrupted in this state, microcomputer (21) operated by means of secondary power supply (34). In step S9, interruption of the AC power supply is detected, and, in

step S10, the time clock is reset, the cooling time is set to zero, and zero is stored in nonvolatile memory (35). Step S11 is for other processing.

[0034]

Then, in step S4, when the power supply is turned off, in step S12, off mode of the set power supply is determined, and, in step S13, the fan power supply is turned on. As a result, when fan (27) is stopped, fan controller (28) controls fan (27) to rotate, and, after fan (27) has rotated for a prescribed time, in the succeeding step S14, the lamp power supply is turned off. As a result, lamp power supply circuit (26) turns off lamp (25). In this way, when the lamp power supply is off, in step S15, microcomputer (21) rests the time clock, sets the cooling time to zero, and stores zero in nonvolatile memory (35).

[0035]

Also, in step S16, it is determined whether the AC power supply is interrupted in this state. If it is not interrupted, microcomputer (21) counts up the cooling time by means of the time clock. In step S17, it is determined that the cooling time of lamp (25) has reached the prescribed time, and, in step S18, the fan power supply is turned off. In this way, when the power supply is off, fan (27) is driven to rotate for a prescribed time to cool lamp (25), and the power supply is then turned off.

[0036]

When interruption of the power supply is detected in step S16, in step S 19, count-up of the cooling time of microcomputer (21) is ceased, the count value at the time of interruption of the AC power supply is stored in nonvolatile memory (34), and the process goes to preceding step S11 (another process).

[0037]

When the AC power supply is interrupted during operation, in step S10, the count value of the cooling time is zero, and, in step S19, counting of the cooling time is stopped. Consequently, even when the AC power supply is reset later, in step S6, until the cooling time of the lamp reaches the prescribed time, instead of going to the next step S7 for turning on power to the lamp, turning-on of the lamp can be stopped until a prescribed time has elapsed after turning off the lamp.

[0038]

Then, as shown in Figure 3, operation is carried out based on the time that has elapsed after turning off the lamp. This operation differs from that shown in Figure 2 in that steps S6, S10, S15, S17 and S19 are substituted by steps S6b, S10b, S15b, S17b and S19b, respectively.

[0039]

In step S6b, the current time is compared with the time stored in nonvolatile memory (12), and whether the prescribed time has elapsed according to the stored time is determined. In step S10b, the time of interruption of the AC power supply is stored in nonvolatile memory (12). Also, in step S15b, the time of the lamp power supply being turned off is stored in nonvolatile memory (12). In step S17b, the current time is compared with the time stored in nonvolatile memory (12), and whether the prescribed time has elapsed according to the stored time is determined. In step S19b, the time of interruption of the AC power supply is stored in nonvolatile memory (12).

[0040]

That is, the operation after the AC power supply is turned on in step S1 to the time when the fan power supply is turned on in step S5 is the same as that in the aforementioned example. In step S6b, the data from nonvolatile memory (35) are read. The current time is compared with the time stored in nonvolatile memory (12), and whether the prescribed time has elapsed according to the stored time is judged. That is, whether the time from lamp (25) being off to the current time is the prescribed time is determined. If the elapsed time is longer than the prescribed time, it is taken that the temperature of the lamp has decreased, and the lamp power supply is turned on in the next step S7.

[0041]

In step S6b, until the prescribed time has elapsed, the process does not go to the next step S7, and, at the time the prescribed time is reached, lamp power supply circuit (26) turns on lamp (25). In step S10b, when interruption of the AC power supply is detected in step S9, the time of interruption of the AC power supply is stored in nonvolatile memory (12).

[0042]

On the other hand, in step S15b, the time the lamp power supply is turned off is stored in nonvolatile memory (12). In step S17b, when there is no interruption of the AC power supply, the current time is compared with the time stored in nonvolatile memory (12), and it is determined from the stored time whether the prescribed time has elapsed. With the result of the

determination, the process goes to step S18 for the next instance of turning-off of the fan power supply.

[0043]

In step S19b, the time of interruption of the AC power supply is stored in nonvolatile memory (12). The stored data are used in step S6b when the AC power supply is next turned on.

[0044]

In this way, when the AC power supply is interrupted during operation, in step S10b, the time of interruption of the AC power supply is stored. In step S19, too, the time of interruption of the AC power supply is stored in the same way. Even when the AC power supply is reset later, in step S6b, based on the current time, the time that has elapsed from interruption of the AC power supply is determined, and, until the elapsed time reaches the prescribed time, the process does not go to step S7 of the next turning on of the lamp power supply, so that it is possible to prevent turning-on of the lamp until the prescribed time has elapsed.

[0045]

Even when there is no interruption of the AC power supply during operation, in step S15b, the time the lamp power supply has been turned off is stored, so that when the power supply is reset later, in step S6b, based on of the current time, the time elapsed from turning off of the lamp power supply is determined, and, until the elapsed time reaches the prescribed time, the process does not go to step S7 of the next ON of the lamp power supply, and it is possible to prevent turning-on of the lamp until the temperature of the lamp is lower than the prescribed temperature.

[0046]

Figure 4 shows the flow chart of the operation using display circuit (37). It differs from that shown in Figure 2 in that steps S6, S10, S17 and S19 are substituted by steps S6c, S10c, S17c and S19c, respectively. Step S15 is omitted.

[0047]

In step S6c, it is determined whether LED of display circuit (37) is flashing, that is, whether there is an abnormality. In step S10c, LED of display circuit (37) flashes for a prescribed time to inform the user of the abnormality. In step S17c, it is determined whether the cooling time by fan (7) is the prescribed time. In step S19c, LED of display circuit (37) flashes for a prescribed time, and the user is informed of the abnormality.

[0048]

That is, the operation after the AC power supply is turned on in step S1 to the time when the fan power supply is turned on in step S5 is the same as that in the aforementioned example. In step S6c, whether LED of display circuit (37) is flashing, that is, whether there is an abnormality, is checked. Because the LED is flashing until the lamp is sufficiently cooled , the lamp power supply is turned on in the next step S7 after the end of flashing.

[0049]

In step (10c), LED of display circuit (37) flashes for a prescribed time to inform the user of the abnormality. When the AC power supply is interrupted, LED flashes to indicate the abnormal off operation. Also, in the case of a power outage, the user is informed of the state.

[0050]

In step S17c, it is determined whether the cooling time using fan (7) is the prescribed time. A prescribed time is counted from when the lamp is turned off due to a conventional interruption of the power supply or interruption of the AC power supply, and it is determined whether a sufficient time for cooling of the lamp has elapsed. In step S19c, LED of display circuit (37) is made to flash for a prescribed time to inform the user of the abnormality. When the AC power supply is interrupted, the LED is made to flash to indicate the abnormal off operation.

[0051]

In this way, when the AC power supply is interrupted during operation, the user can be informed of the abnormal operation. In addition, when the cooling time of the lamp is insufficient due to interruption of the AC power supply or the like, the LED is made to flash, and flashing of LED is stopped after a prescribed cooling time has elapsed. When the cooling state of the lamp is insufficient at the time of reset of the AC power supply, it enters standby mode for turning on the lamp power supply.

[0052]

In the example explained above, display circuit (37) makes the LED flash to inform the user of the abnormal state. However, one may also adopt a method in which a liquid crystal display panel or the like is used to display a message for prompting the user to restore normal operation. In this case, the display continues until the lamp has been sufficiently cooled, and the display is stopped at the time when sufficient cooling has been reached.

[0053]

Figure 5 shows the flow chart of the operation using temperature sensor (36). It differs from that shown in Figure 2 in that steps S6, S17 are substituted by steps S6d, S17d, respectively, while steps S10, S15 and S19 are omitted in this case.

[0054]

In step S6d, the value of temperature sensor (36) is read, and it is determined whether the temperature of lamp (25) is lower than the prescribed temperature. In step S17d, too, the value of temperature sensor (36) is read in the same way, and it is determined whether the temperature of lamp (25) is lower than the prescribed temperature.

[0055]

In this case, too, the operation from step 1 when the AC power supply is turned on to step 5 when the fan power supply is turned on is the same as that in the aforementioned example. In step S6d, the value of temperature sensor (36) is read and it is determined whether the temperature of lamp (25) is lower than the prescribed value. If the temperature is lower than the prescribed temperature, in step S7, the lamp power supply is turned on. If the value of temperature sensor (36) exceeds the prescribed level in step S6d, the process does not go to step S7 when the lamp power supply is turned on until the temperature is lower than the prescribed temperature.

[0056]

In step S17d, the value of temperature sensor (36) is also read just as mentioned previously, and, it is determined whether the temperature of lamp (25) is lower than the prescribed level. When the conventional power supply is turned off, the value of temperature sensor (36) is read, and, if the temperature of the lamp is lower than the prescribed temperature, the fan power supply is turned off in the next step S18.

[0057]

In this way, when the AC power supply is interrupted during operation, corresponding to the result of detection of the temperature of the lamp, if the temperature of the lamp is lower than the prescribed level, it is possible to keep the standby mode even when the lamp power supply is manipulated to be turned on.

[0058]

Figure 6 shows the flow chart of the operation by opening/closing of lamp cover (38). It differs from that shown in Figure 2 in that steps S6, S10, S17 and S19 are substituted by steps S6e, S10e, S17e and S19e, respectively, while step S15 is omitted.

[0059]

In step S6e, it is determined whether lamp cover (38) is closed. In step S10e, lamp cover (38) is opened. In step S17e, it is determined whether the cooling time by fan (7) has reached the prescribed time. In step S19c, lamp cover (38) is opened.

[0060]

That is, the operation from step S1 when the AC power supply is turned on to step S5 when the fan power supply is turned on is the same as that in the aforementioned example. In step S6e, it depends on whether lamp cover (38) is closed. When lamp cover (38) is opened, cooling of the lamp is insufficient. When lamp cover (38) is closed, it is determined that the lamp has cooled, and the lamp power supply is turned on in the next step S7.

[0061]

In step S10e, when the AC power supply is interrupted, lamp cover (38) is opened, and the temperature of the lamp decreases. In step S17e, it is determined whether the cooling time by fan (7) reaches the prescribed time. A prescribed time is counted from the time the lamp is turned off due to a conventional turning-off of the power supply, and it is determined whether a sufficient time for cooling the lamp has elapsed.

[0062]

In addition, in step S19e, lamp cover (38) is opened. That is, as lamp cover (38) is opened when the AC power supply is interrupted, the temperature of lamp cover (38) decreases. In this way, when the AC power supply is interrupted during operation, it is possible to open lamp cover (38) to exhaust the heat from within the lamp to decrease the temperature.

[0063]

Also, when lamp cover (25) is opened/closed, the result of detection of temperature sensor (36) is used. When the temperature of the lamp is lower than the prescribed temperature, lamp cover (38) is closed, or the time clock of the microcomputer is used, and lamp cover (38) is closed when the cooling time of the lamp is longer than a prescribed time or when the time from interruption of the AC power supply is longer than a prescribed time.

[0064]

As explained above, according to the present invention, even when the AC power supply is suddenly interrupted, if the temperature of the lamp exceeds a prescribed level, it enters standby mode for turning on the lamp power supply, and the lamp power supply is turned on when the temperature of the lamp is lower than the prescribed temperature, and it is possible to prevent stress on the microcomputer or the like due to the noise when the lamp is turned on. Also, the user can be informed of abnormal operation in case of interruption of the AC power supply.

[0065]

In Figures 4 and 6, steps S17c and S17e refer to determination of whether the cooling time is the prescribed time in the aforementioned example. However, one may also adopt a method in which the detection result of temperature sensor (36) is determined.

[0066]

Effects of the invention

According to the present invention, even when the AC power supply is suddenly interrupted, if the temperature of the lamp exceeds a prescribed temperature, it enters standby mode for turning on the lamp power supply. When the temperature of the lamp is lower than the prescribed temperature, the lamp power supply is turned on.

Brief description of the figures

Figure 1 is a block diagram illustrating the constitution of the projection type display device of the present invention.

Figure 2 is a flow chart illustrating the operation of an embodiment of the present invention.

Figure 3 is a flow chart illustrating the operation in Embodiment 2 of the present invention.

Figure 4 is a flow chart illustrating the operation in Embodiment 3 of the present invention.

Figure 5 is a flow chart illustrating the operation in Embodiment 4 of the present invention.

Figure 6 is a flow chart illustrating the operation in Embodiment 5 of the present invention.

Figure 7 is a block diagram illustrating the constitution of the projection type display device of the prior art.

Explanation of symbols

21 Microcomputer
22 Operation part
23 Input circuit
24 Power supply circuit
25 Light source lamp
26 Lamp power supply circuit
27 Fan
28 Fan controller
29 Liquid crystal panel
30 Image processor
32 Projecting lens
34 Secondary power supply
35 Nonvolatile memory
36 Temperature sensor
37 Display circuit (LED)
38 Lamp cover
39 Lamp cover opening/closing circuit

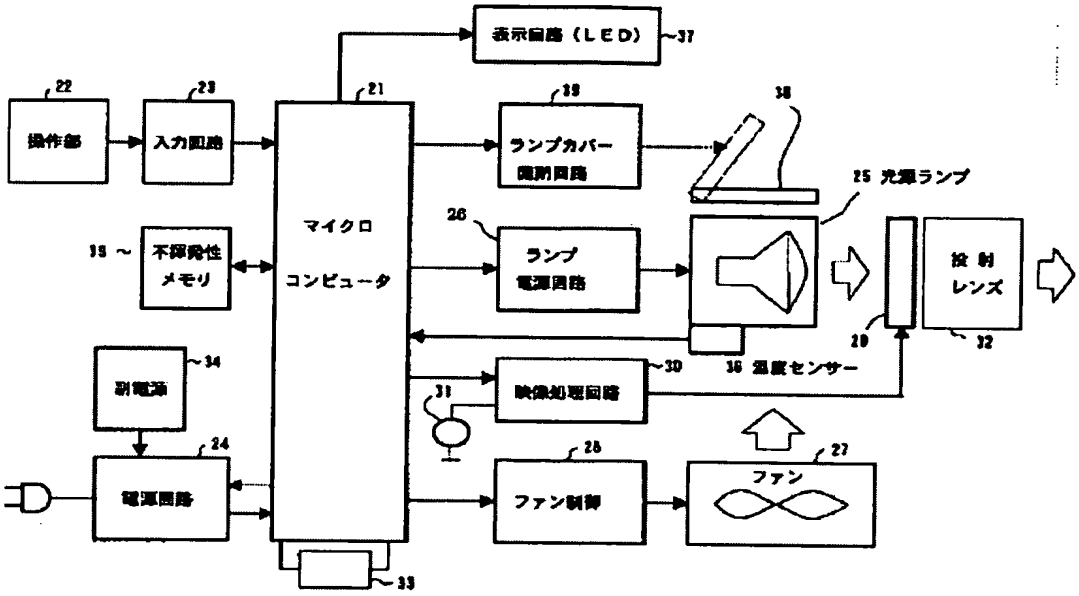


Figure 1

Key:
21 Microcomputer
22 Operation part
23 Input circuit
24 Power supply circuit
25 Light source lamp
26 Lamp power supply circuit
27 Fan
28 Fan controller
30 Image processor
32 Projection lens
34 Secondary power supply
35 Nonvolatile memory
36 Temperature sensor
37 Display circuit (LED)
38 Lamp cover opening/closing circuit

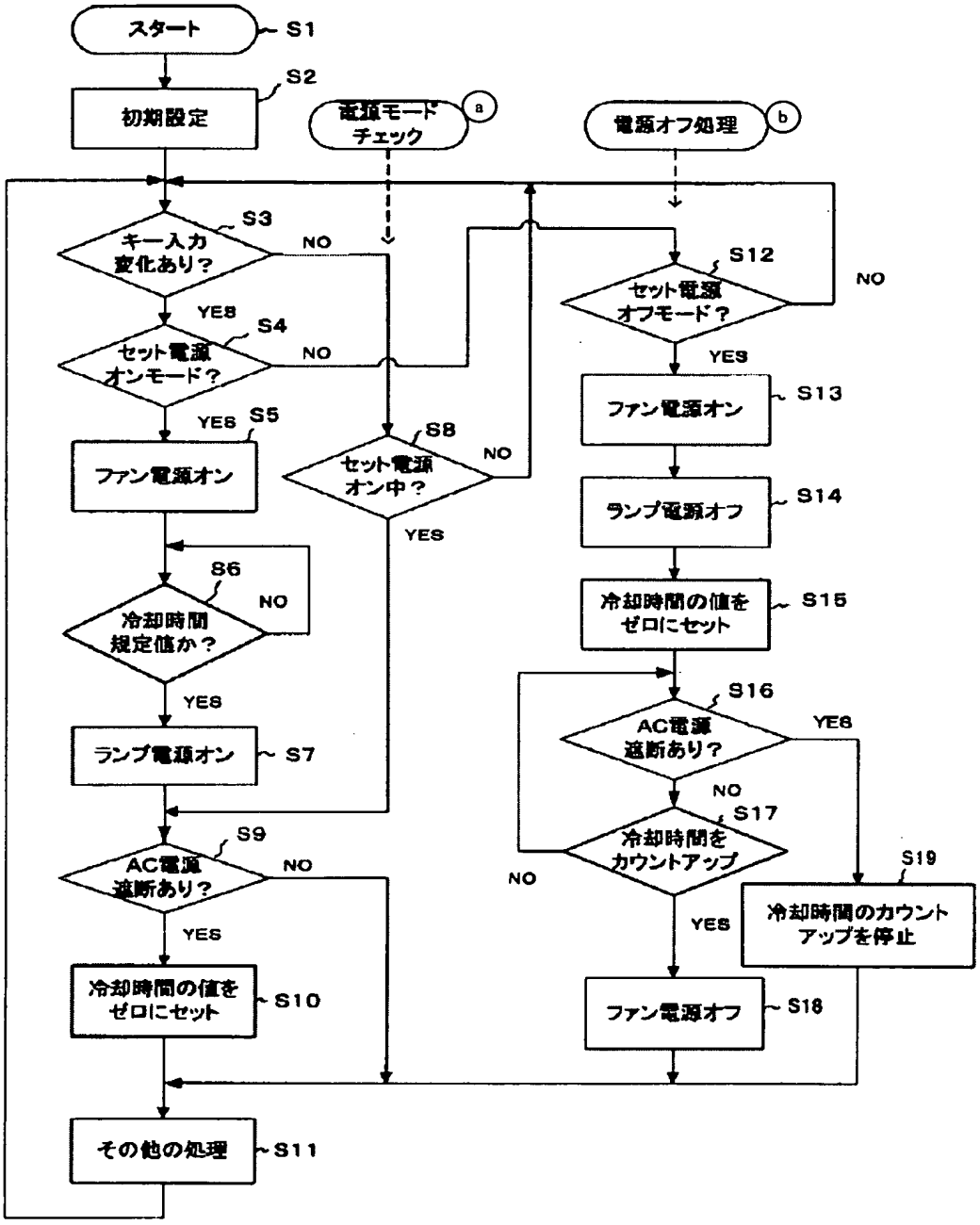


Figure 2

Key: a Check of power supply mode
b Process of turning off power supply

S1 START
S2 Initial setting
S3 Change in key input?
S4 Set in power supply on mode?
S5 Fan power supply on
S6 Is cooling time now the prescribed time?
S7 Lamp power supply on
S8 Power supply being turned on?
S9 Is AC power supply interrupted?
S10 Setting of value of cooling time to zero
S11 Other processes
S12 Set in power supply off mode?
S13 Fan power supply on
S14 Lamp power supply off
S15 Setting of value of cooling time to zero
S16 Has AC power supply been interrupted?
S17 Count up of cooling time?
S18 Fan power supply off
S19 Count up of cooling time is stopped

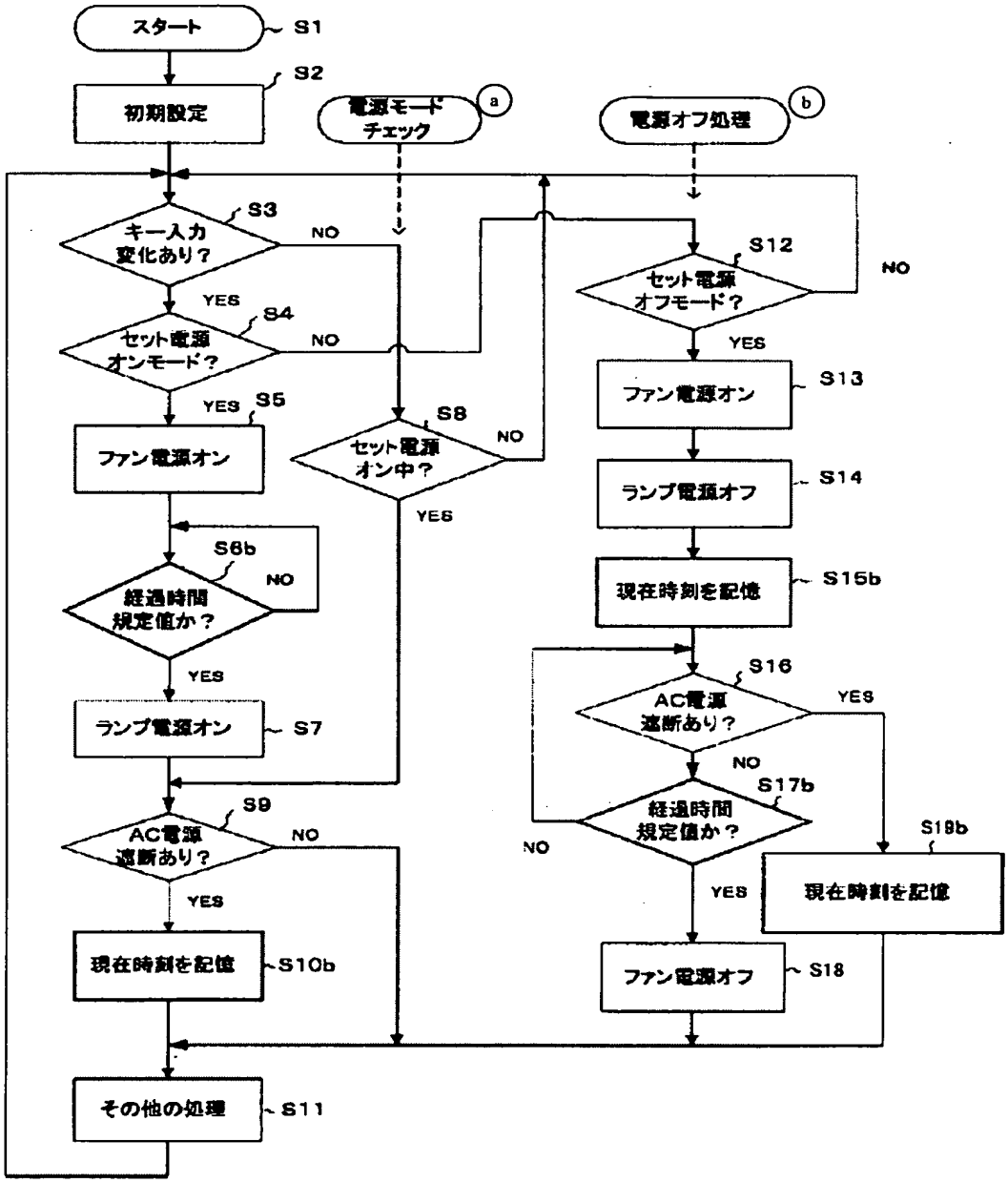


Figure 3

Key:
- a Check of power supply mode
- b Process for turning off power supply
- S1 START
- S2 Initial setting

S3 Change in key input?
S4 Set in power supply on mode?
S5 Fan power supply on
S6b Is the elapsed time the prescribed time?
S7 Lamp power supply on
S8 Is set power supply being turned on?
S9 Is AC power supply interrupted?
S10b Storage of current time
S11 Other processes
S12 Set in power supply off mode?
S13 Fan power supply on
S14 Lamp power supply off
S15b Storage of current time
S16 Has AC power supply been interrupted?
S17 Is the elapsed time the prescribed time?
S18 Fan power supply off
S19b Storage of current time

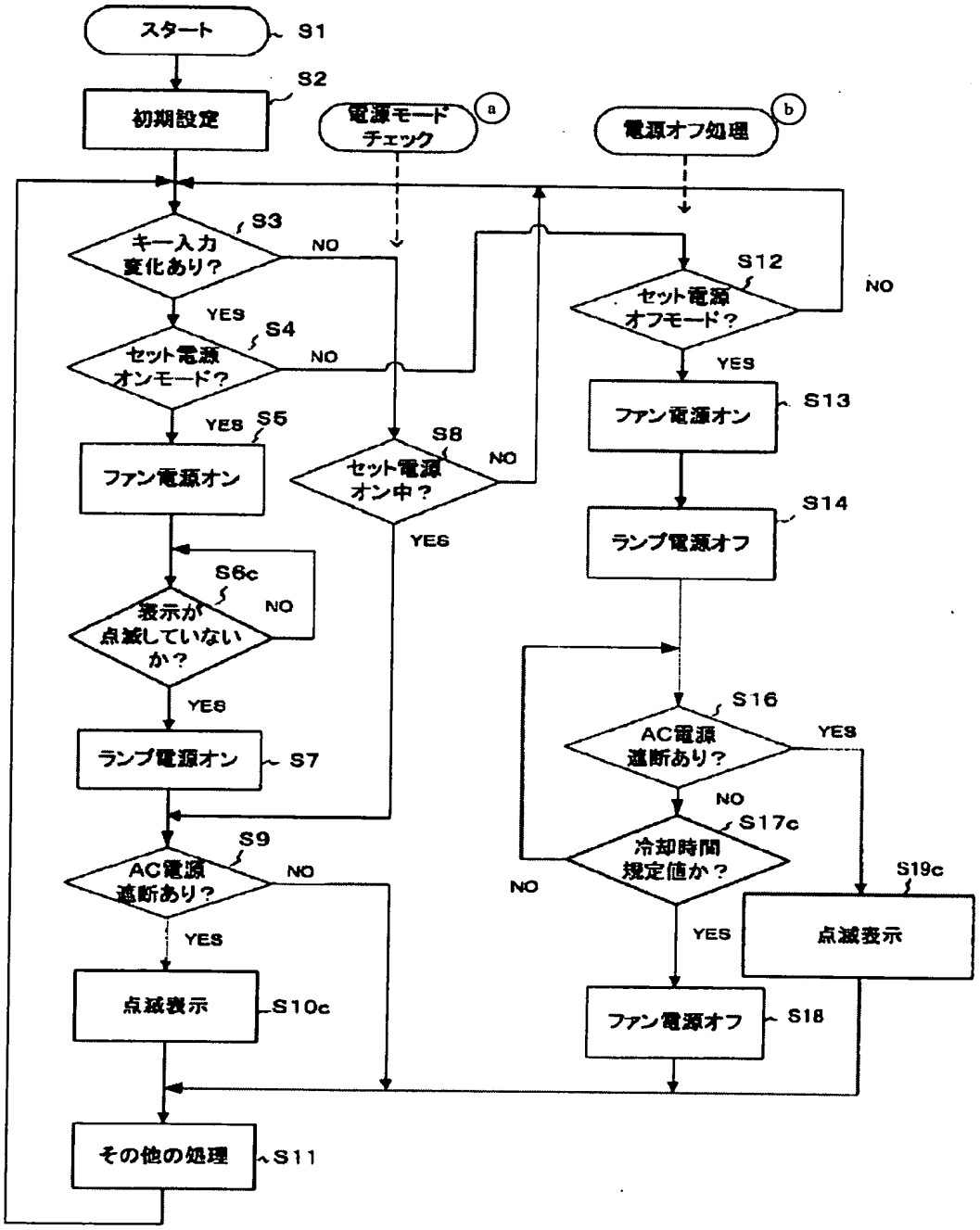


Figure 4

Key: a Check of power supply mode
b Process for turning off power supply

S1 START
S2 Initial setting
S3 Change in key input?
S4 Set in power supply on mode?
S5 Fan power supply on
S6c Display is not flashing?
S7 Lamp power supply on
S8 Is set power supply being turned on?
S9 Has AC power supply been interrupted?
S10c Flashing display
S11 Other processes
S12 Set in power supply off mode?
S13 Fan power supply on
S14 Lamp power supply off
S16 Has AC power supply been interrupted?
S17c Is cooling time the prescribed time?
S18 Fan power supply off
S19c Flashing display

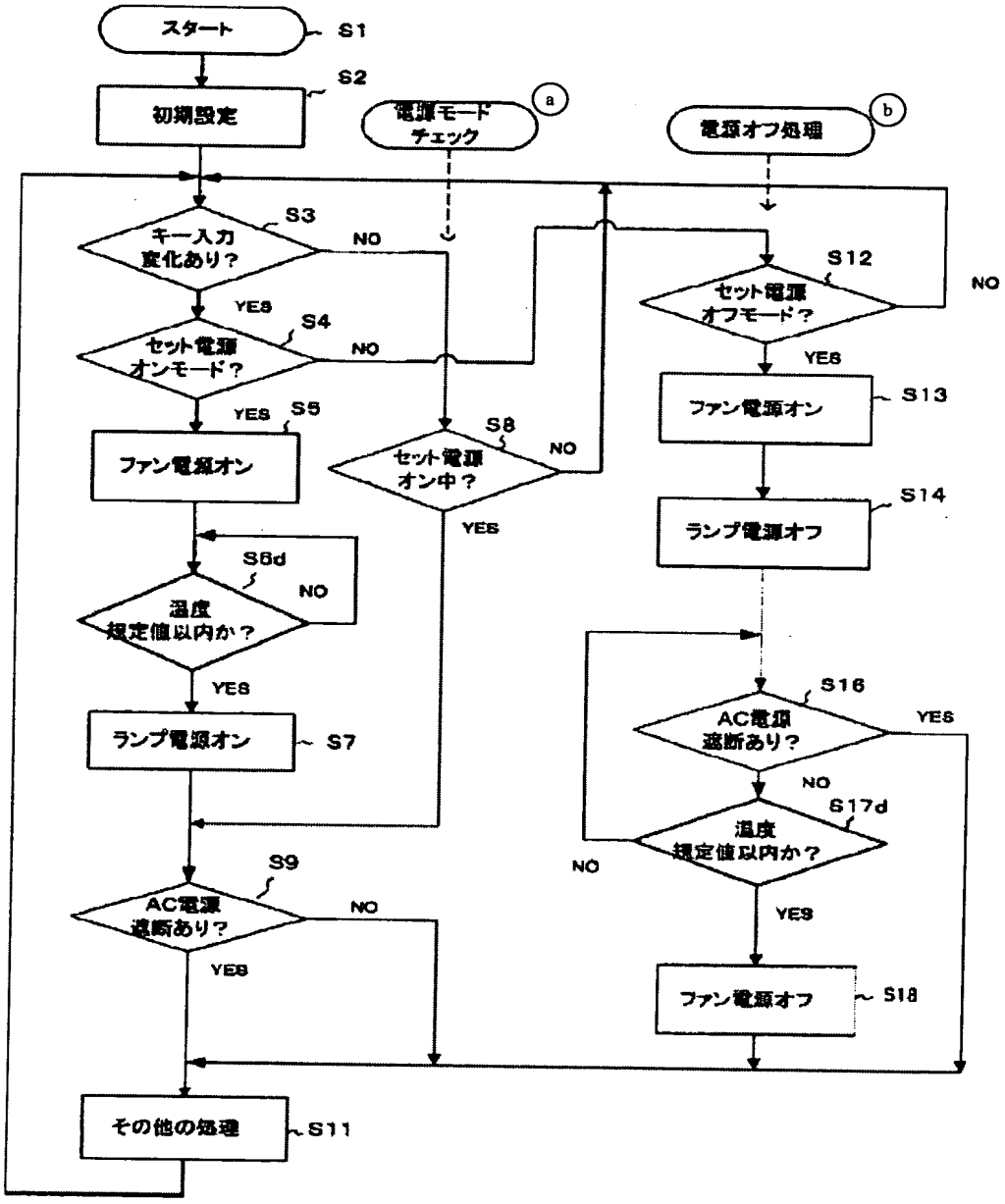


Figure 5

Key:
- a Check of power supply mode
- b Process for turning off power supply
- S1 START
- S2 Initial setting
- S3 Change in key input?

S4 Set in power supply on mode?
S5 Fan power supply on
S6d Is the temperature lower than the prescribed level?
S7 Lamp power supply on
S8 Is set power supply being turned on?
S9 Has AC power supply been interrupted?
S11 Other processes
S12 Set in power supply off mode?
S13 Fan power supply on
S14 Lamp power supply off
S16 Has AC power supply been interrupted?
S17d Temperature lower than prescribed level?
S18 Fan power supply off

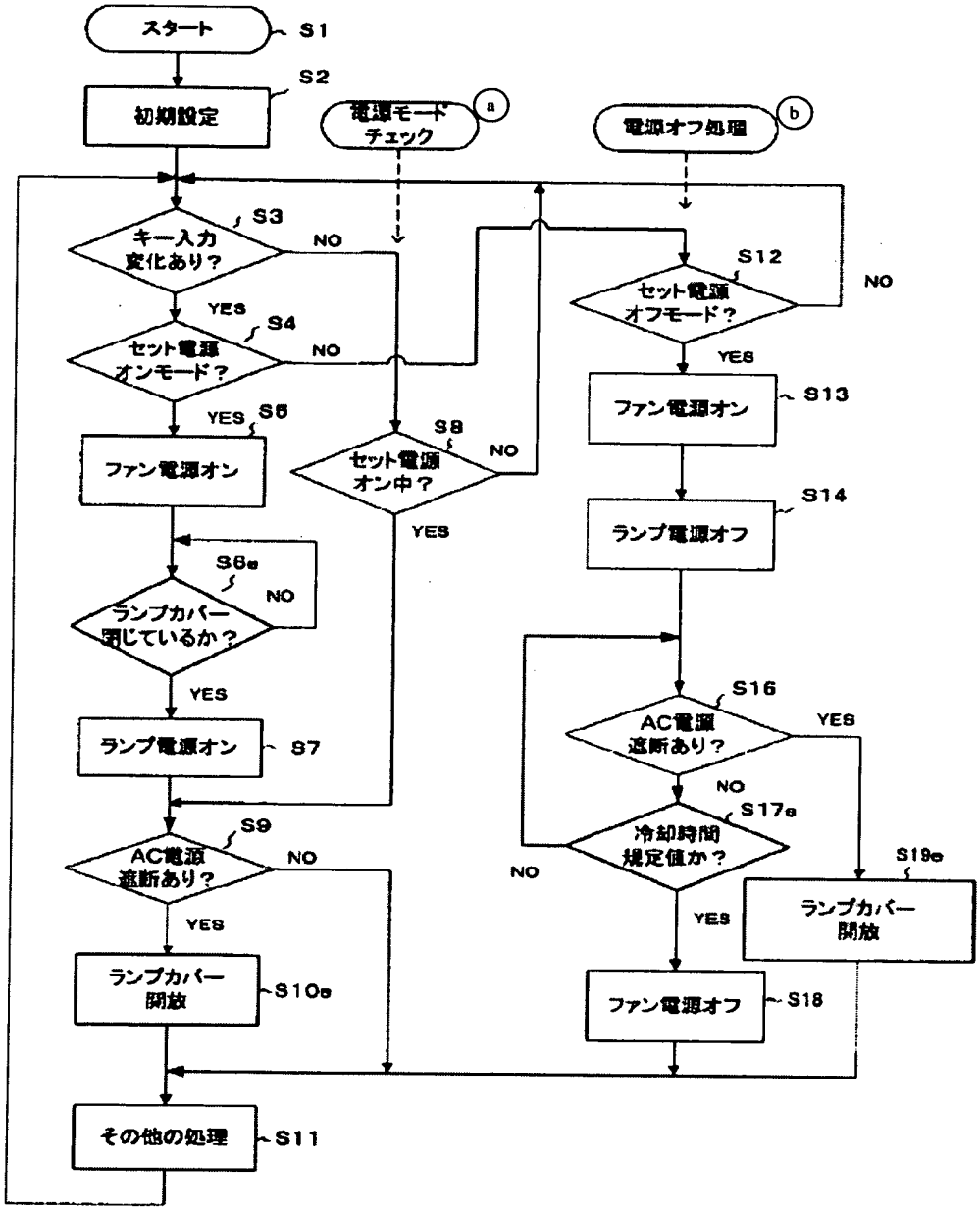


Figure 6

Key:
- a Check of power supply mode
- b Process for turning off power supply
- S1 START
- S2 Initial setting
- S3 Change in key input?

S4 Set in power supply on mode?
S5 Fan power supply on
S6e Is lamp cover closed?
S7 Lamp power supply on
S8 Is set power supply being turned on?
S9 Has AC power supply been interrupted?
S10e Opening of lamp cover
S11 Other processes
S12 Set in power supply mode?
S13 Fan power supply on
S14 Lamp power supply off
S16 Has AC power supply been interrupted?
S17e Is cooling time the prescribed time?
S18 Fan power supply off
S19e Opening of lamp cover

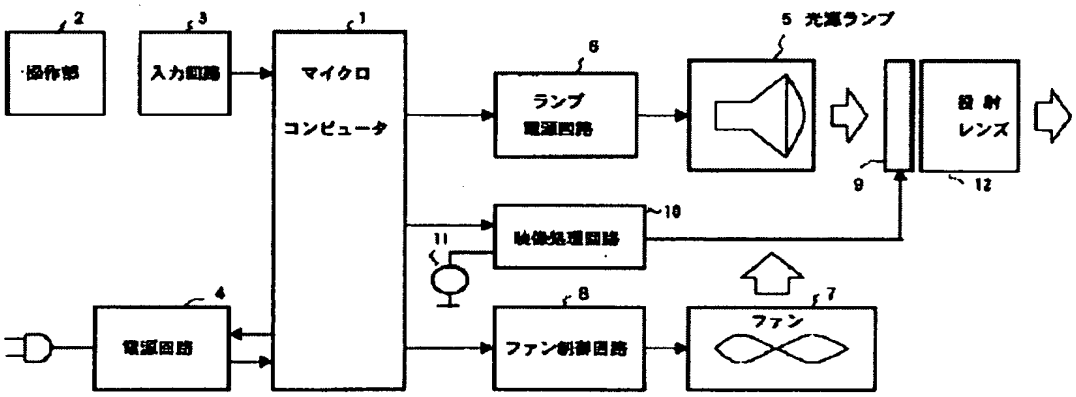


Figure 7

Key: 1 Microcomputer
2 Operation part
3 Input circuit
4 Power supply circuit
5 Light source lamp
6 Lamp power supply circuit
7 Fan
8 Fan controller
10 Image processor
12 Projection lens

Continued from front page

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